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Chapter 1 - Introduction

1.1 Purpose and Scope

The objective of this Manual is to provide guidance in stormwater design and management for eastern Washington. The Manual aims to provide a commonly accepted set of technical standards in addition to presenting new design information and new approaches to stormwater management. These stormwater management practices, if properly applied at a project site, should protect water quality in the receiving waters (both surface and ground waters). Improperly managed stormwater runoff is one of the principal sources of water quality and habitat degradation in urban areas. A number of existing laws and regulations require that project proponents properly manage stormwater runoff to avoid adverse impacts to water quality and aquatic resources. This Manual is intended to provide technically sound and realistic guidance on how to properly manage stormwater runoff from individual project sites.

This Manual identifies eight Core Elements for managing stormwater runoff from new development and redevelopment projects of all sizes. The Manual also provides guidance for preparation and implementation of stormwater site plans. The requirements of the Core Elements are generally satisfied by the application of Best Management Practices (BMPs) selected from Chapters 5 through 8 of this Manual. Projects that follow this approach will apply reasonable, technology-based BMPs and water quality-based BMPs to reduce the adverse impacts of stormwater.

This Manual is applicable to all types of land development. BMPs for residential, commercial and industrial development and road projects are included. A Manual with a more specific focus, such as a Highway Runoff Manual or a stormwater manual adopted by a local jurisdiction, may provide more appropriate guidance to the project proponent.

The Manual is limited in scope for addressing environmental problems caused by urbanization. The Manual does not include site development standards or limit where development should be allowed. Project by project management of stormwater runoff from new development and redevelopment alone will not correct existing water quality and instream habitat problems. The engineered runoff treatment and flow control facilities recommended in this Manual can reduce the adverse impacts of development, but such facilities cannot remove sufficient pollutants to replicate the pre-development water quality, nor can they replicate the natural functions of the watershed that existed before development.

This Manual is applicable to all of eastern Washington, including the area bounded on the west by the Cascade Mountains crest; on the north by the Canadian border; on the east by the Idaho border; and on the south by the Oregon border. At the southern end of Washington’s Cascade Mountain range where the crest does not follow county borders, this Manual is applicable to all of Yakima and Klickitat Counties.

1.1.1 The Manual's Role as Technical Guidance

The *Stormwater Management Manual for Eastern Washington* is not a regulation. The Manual does not have any independent regulatory authority and it does not establish new environmental regulatory requirements. Current law and regulations require project proponents to design, construct, operate, and maintain stormwater treatment systems that prevent pollution of State waters. The Manual is a guidance document which provides local governments, state and federal agencies, developers and project proponents with a set of stormwater management practices. If these practices are implemented correctly, they should result in compliance with existing regulatory requirements for stormwater – including compliance with the federal Clean Water Act, federal Safe Drinking Water Act and state Water Pollution Control Act.

The purpose of this Manual is to provide technical guidance on measures to control the quantity and quality of stormwater runoff from new development and redevelopment projects. These measures are considered to be necessary to achieve compliance with state water quality standards and to contribute to the protection of the beneficial uses of the receiving waters (both surface and ground waters). Stormwater management techniques applied in accordance with this Manual are presumed to meet the technology-based treatment requirement of state law to provide all known available and reasonable methods of treatment, prevention and control (AKART; RCW 90.52.040 and RCW 90.48.010).

This technology-based treatment requirement does not excuse any discharge from the obligation to apply additional stormwater management practices as necessary to comply with State water quality standards. The State water quality standards include: Chapter 173-200 WAC, Water Quality Standards for Ground Waters of the State of Washington; Chapter 173-201A, Water Quality Standards for Surface Waters of the State of Washington; and Chapter 173-204, Sediment Management Standards. Additional treatment to meet those standards may be required by federal, state, or local governments.

Following this Manual is not the only way to properly manage stormwater runoff. A project proponent may choose to implement other practices to protect water quality; but in this case, the project proponent assumes the responsibility of providing technical justification that the chosen practices will protect water quality (see Section 1.1.3, Presumptive versus Demonstrative Approaches to Protecting Water Quality below).

1.1.2 More Stringent Measures and Retrofitting

Federal, state, and local government agencies with jurisdiction can require more stringent measures that are deemed necessary to meet locally established goals, state water quality standards, or other established natural resource or drainage objectives. Water cleanup plans or Total Maximum Daily Loads (TMDLs) may identify more stringent measures needed to restore water quality in an impaired water body.

This Manual is not a retrofit manual, but it can be helpful in identifying options for retrofitting BMPs to existing development. Retrofitting stormwater BMPs into existing developed areas may be necessary to meet federal Clean Water Act and state Water Pollution Control Act (Chapter 90.48 RCW) requirements. In retrofit situations there frequently are site constraints that make the strict application of these BMPs difficult. In these instances, the BMPs presented here can be modified using best professional judgment to provide reasonable improvements in stormwater management.

1.1.3 Presumptive versus Demonstrative Approaches to Protecting Water Quality

Wherever a discharge permit or other water-quality-based project approval is required, project proponents may be required to document the technical basis for the design criteria used to design their stormwater management BMPs. This includes: how stormwater BMPs were selected; the pollutant removal performance expected from the selected BMPs; the scientific basis, technical studies, and(or) modeling which supports the performance claims for the selected BMPs; and an assessment of how the selected BMP will comply with state water quality standards and satisfy state AKART requirements and federal technology-based treatment requirements.

The Manual is intended to provide project proponents, regulatory agencies, and others with technically sound stormwater management practices which are *presumed* to protect water quality and instream habitat – and meet the stated environmental objectives of the regulations described in this chapter. Project proponents always have the option of not following the stormwater management practices in this Manual. However, if a project proponent chooses not to follow the practices in the Manual then the project proponent may be required to individually *demonstrate* that the project will not adversely impact water quality by collecting and providing appropriate supporting data to show that the alternative approach is protective of water quality and satisfies state and federal water quality laws.

Figure 1.1 graphically depicts the relation between the *presumptive approach* (the use of this Manual) and the *demonstrative approach* for achieving the environmental objectives of the standards. Both the presumptive and demonstrative approaches are based on best available science and result from existing federal and state laws that require stormwater treatment systems to be properly designed, constructed, maintained, and operated to: all known available and reasonable methods to prevent and control the pollution of the waters of the state

Figure 1.1 – Relation between environmental science and standards in stormwater regulations. Both the presumptive and demonstrative approaches are based on using best available science to protect water quality. See the glossary for definitions.

STANDARDS

Water Pollution Control Act

(Chapter 90.48 RCW)

Discharges to state waters shall not cause pollution, defined as alteration of the physical, chemical or biological properties of state waters which would impair beneficial uses. Requires use of all known and reasonable methods to prevent and control pollution (AKART).

Clean Water Act

Restore and maintain the chemical, physical, and biological integrity of the nation's waters.

- State water quality standards (water-quality based treatment requirements)
- Federal technology-based treatment requirements
- National Pollutant Discharge Elimination System (NPDES) permits
- 303(d) impaired waterbody list and water clean-up plans

Others

Hydraulics Code

- Hydraulic Project Approvals (HPAs)

Safe Drinking Water Act

- Underground Injection Control (UIC) program

Endangered Species Act

- Properly functioning conditions

Presumptive Approach

The Stormwater Management Manual for Eastern Washington provides a default set of stormwater practices based on current science which satisfy State and Federal stormwater requirements.

Considerations:

- More predictable, practices are approved across jurisdictions
- Costly studies, etc. are not required as they may be under the demonstrative approach

Demonstrative Approach

Project sponsor and approval agency individually review and condition proposed projects to meet federal and state stormwater standards based on current science.

Considerations:

- Lacks predictability and can be very time consuming
- For large, complex projects may reduce costs and/or improve environmental protection

Hydrology

- When native vegetation is removed and replaced with impervious surfaces (roads or buildings) there is an increase in stormwater runoff and a decrease in summer base flows.
- Increased flows lead to increased flooding and stream bank and stream bed erosion.
- Unless mitigated, adverse high flow impacts occur at even low levels of urban development: 4% to 10% total impervious area.
- Transportation infrastructure (including parking areas) represents between 50% and 75% of the impervious surface area within any single watershed.

Water Quality

- More than a third of the state's urban streams, creeks, and embayments are impaired due to stormwater runoff.
- Stormwater runoff from construction activities can contain large amounts of sediments and suspended solids which are harmful to fish and other aquatic life.
- Untreated stormwater from roads and urban areas can adversely impact water quality due to sediments, toxic metals, pesticides, herbicides, oils and greases, and possible human pathogens including fecal coliform bacteria.
- Untreated stormwater runoff from roads and urban areas can be toxic to aquatic life including fish.

SCIENCE

1. Prevent pollution of state waters and protect water quality, including compliance with state water quality standards;
2. Satisfy state requirements for all known available and reasonable methods of prevention, control and treatment (AKART) of wastes prior to discharge to waters of the State; and
3. Satisfy the federal technology based treatment requirements under 40 CFR part 125.3.

Under the demonstration approach, the timeline and expectations for providing technical justification of stormwater management practices will depend on the complexity of the individual project and the nature of the receiving environment. In each case, the project proponent may be asked to document to the satisfaction of the permitting agency or other approval authority that the practices which have been selected for the individual project will result in compliance with the water quality protection requirements of the permit or other local, state, or federal water-quality-based project approval condition(s). This approach may be more cost effective for large, complex, or unusual types of projects.

Project proponents who choose to follow the stormwater management practices contained in approved stormwater technical manuals are presumed to have satisfied this demonstration requirement and do not need to provide technical justification to support the selection of BMPs for the project. Following the stormwater management practices in this Manual means adhering to the guidance provided for proper selection, design, construction, implementation, operation, and maintenance of BMPs. Approved stormwater technical manuals include this Manual and other equivalent stormwater management guidance documents approved by Ecology. This approach will generally be more cost effective for typical development and redevelopment projects.

1.1.4 Comparison of the Stormwater Management Manuals for Eastern and Western Washington

Both the *Stormwater Management Manual for Eastern Washington* (SWMMEW) and the *Stormwater Management Manual for Western Washington* (SWMMWW) are based on the same standard: protecting water quality. The manuals are organized differently, with the SWMMEW comprised of eight chapters and the SWMMWW comprised of five volumes. The eight Core Elements of the SWMMEW include the same goals as the ten Minimum Requirements of the SWMMWW, but again, the organization is different. Differences in climate, hydrology, and the current understanding of rainfall-runoff relationships on the two sides of the state led to different approaches in the two manuals for designing and sizing treatment facilities. Special considerations for the arid climate and for freezing weather are included in the SWMMEW but not in the SWMMWW. As we gain better understanding of the natural systems on both sides of the state and as approaches to managing stormwater continue to improve, both manuals will be updated.

1.2 Effects of Urbanization

Managing stormwater may not seem necessary in arid and semi-arid regions where rainfall is generally a welcome event. However, the quality and habitat function of receiving waters in arid and semi-arid climates are affected by pollutants carried by stormwater runoff and by the changes in the patterns of runoff from the land following development. Hydrologic and water quality changes caused by urbanization can result in irreversible changes to the biological systems that were supported by the natural hydrologic system.

1.2.1 Water Quality Changes

Although few data are available specifically from eastern Washington, studies across the nation have found that urbanization causes increases in the types and quantities of pollutants in receiving waters. Regardless of the climatic setting, runoff from urban areas has been shown to contain many different types of pollutants, depending on the nature of the activities in those areas.

- The runoff from roads and highways is contaminated with pollutants from vehicles, and typical pollutants in road runoff include: oil and grease, polynuclear aromatic hydrocarbons (PAHs), lead, zinc, copper, cadmium, sediments (soil particles), and road salts and other anti-icers.
- Runoff from industrial areas typically contains even more types of heavy metals, sediments, and a broad range of man-made organic pollutants, including phthalates, PAHs and other petroleum hydrocarbons.
- Runoff from commercial areas contains concentrated road-based pollutant runoff and may also contain other pollutants typical of industrial and/or residential areas.
- Residential areas contribute the same road-based pollutants to runoff, as well as herbicides; pesticides; nutrients (from fertilizers and animal wastes); and bacteria, viruses and other pathogens (from animal wastes).

The pollutants in urban runoff can be dissolved in the water column or can be attached to solid particles that settle in streambeds, lakes, or wetlands. All of these contaminants can impair the beneficial uses of the receiving waters (both ground and surface waters). Metals are of particular concern for discharges to surface waters due to the sensitivity of aquatic life to fairly low concentrations, especially copper and zinc. Pesticides and PAHs are of particular importance to discharges to groundwater.

Table 1.1 shows typical concentrations of a limited number of pollutants found in urban stormwater runoff. The pollutant concentrations in stormwater runoff from arid watersheds tend to be higher than that of humid watersheds, since rain events are infrequent and pollutants have more time to accumulate on impervious surfaces. Pervious areas in arid and semi-arid regions also tend to produce higher sediment and organic carbon concentrations because the sparse vegetative cover does little to prevent soil erosion in uplands and along channels when it does rain.

Table 1.1 – Mean concentrations of selected pollutants in urban stormwater runoff across the United States and in arid and semi-arid regions.

Source: several studies summarized in Watershed Protection Techniques, Vol. 3 No. 3, March 2000.

Location	Total Suspended Solids (mg/L)	Total Copper (ug/L)	Total Zinc (ug/L)	Total Lead (ug/L)	Total Phosphorus (ug/L)
National Average	78	14	162	68	320
Phoenix, AZ	227	47	204	72	410
Boise, ID	116	34	342	46	750
Denver, CO	384	60	350	250	800
San Jose, CA	258	58	500	105	830
Dallas, TX	663	40	540	330	780

Table 1.2 shows typical concentrations of a limited number of pollutants from stormwater runoff generated by different land uses.

Table 1.2 – Mean concentrations of selected pollutants in stormwater runoff from different land uses in the state of Oregon.

Note: In-pipe industry means the samples were taken in stormwater pipes. Instream industry means the samples were taken in streams flowing through industrial areas. Samples for all other categories were taken from within stormwater pipes.

Source: Strecker et al, *1997.*

Land Use	Total Suspended Solids (mg/L)	Total Copper (ug/L)	Dissolved Copper (ug/L)	Total Zinc (ug/L)	Total Phospho-rus (ug/L)
In-pipe industry	194	53	9	629	633
Instream industry	102	24	7	274	509
Transportation	169	35	8	236	376
Commercial	92	32	9	168	391
Residential	64	14	6	108	365
Open	58	4	4	25	166

Table 1.3 shows typical concentrations of a limited number of pollutants in highway runoff. These pollutants were detected in 46% to 100% of the samples collected for 102 sites with AADT =<30,000 and 93.5% to 100% of the samples collected for 231 sites with AADT >30,000. In this study,

concentrations of cadmium copper, lead, and zinc frequently exceed state surface water quality standards for the protection of aquatic life regardless of whether the annual average daily traffic count on the road was more or less than 30,000; and concentrations of arsenic, chromium, lead, and coliform bacteria frequently exceed state groundwater quality standards.

Table 1.3 – Mean concentrations of selected pollutants in highway stormwater runoff in the state of California.

Source: California Department of Transportation, 2002.

Annual Average Daily Traffic (AADT)	Total Suspended Solids (mg/L)	Dissolved & Total Cadmium (ug/L)	Dissolved & Total Copper (ug/L)	Dissolved & Total Lead (ug/L)	Dissolved & Total Zinc (ug/L)
Less than or equal to 30,000	160	0.13	6.9	1.3	33
		0.32	16	12	90
Greater than 30,000	160	0.30	16	7.6	93
		0.89	39	64	260

The Washington State Department of Transportation submitted data in to Ecology in its fourth year NPDES Program Summary (Molash, 1999) for two state highways: SR8 in Thurston County, with an average daily traffic (ADT) count of 18,000; and SR5 in Clark County, with an ADT of 101,000. For copper, the acute water quality standard was exceeded in 40 percent of the samples collected on each highway, with the concentrations in those samples ranging from 1.1 times the standard to 8.5 times the standard. For zinc, the acute water quality standard was exceeded in 60 percent of the samples collected on SR5 and in 70 percent of the samples collected on SR8, with the concentrations in those samples ranging from 1.3 times the standard to 14 times the standard.

While instream dilution of the higher concentrations from any single project might prevent impairment of the beneficial uses of a water, capacity does not exist in most urban streams to dilute the discharges from all of the sources in the watershed, and the cumulative effect of all of the discharges in the watershed is much more likely to impair the beneficial uses of the receiving water.

Urbanization may also cause changes in water temperature. Stormwater heated from impervious surfaces and exposed treatment and detention ponds may be discharged to streams with less riparian vegetation for shade. Urbanization also reduces recharge of groundwater, a source of cool water contributions to stream flows.

Regardless of the eventual land use conversion, the sediment load produced by a construction site can increase turbidity in the receiving water. Fine sediments can be deposited over the natural sediments of the receiving water and degrade fish spawning areas and instream habitat for other aquatic life.

This Manual provides guidance on runoff treatment practices for reducing the impacts of pollutant-laden stormwater from individual sites through source control, construction stormwater pollution prevention, and water quality treatment Best Management Practices (BMPs). Section 1.4.2 provides the background of developing source control BMPs; Core Element #3 in Chapter 2.2.3 defines the requirements for applying these BMPs. Section 1.4.3 provides the background of developing runoff treatment BMPs; Core Element #5 in Chapter 2.2.5 defines the requirements for applying these BMPs. Core Element #2 in Chapter 2.2.2 and all of Chapter 7 are devoted to construction stormwater pollution prevention.

1.2.2 Hydrologic Changes

Just as the landscape of eastern Washington includes prairies, pine forests, the shrub-steppe, channeled scablands, and vast areas of irrigated and dry land agriculture, the hydrology of streams in eastern Washington varies tremendously. Average annual precipitation varies from 6 to more than 60 inches. Streambed material varies from basalt rock to highly erodible loess soils. Many streams flow only during the relatively wet winter and spring seasons or only during a runoff-producing rainstorm or snowmelt event. The hydrology of other streams has been altered by seasonal irrigation practices.

Regardless of the hydrologic and geologic setting, streams can be impacted by urbanization of their watersheds. As development occurs, land is cleared and impervious surfaces such as roads, parking lots, rooftops, and sidewalks are added. Roads are cut through slopes and low spots are filled. The natural soil structure is lost due to grading and compaction during construction. Drainage patterns are irrevocably altered. Maintained landscapes that have much higher runoff characteristics often replace the natural vegetation. The accumulation of these changes may affect the natural hydrology by:

- Increasing the peak volumetric flow rates of runoff,
- Increasing the total volume of runoff,
- Decreasing the time it takes for runoff to reach a natural receiving water,
- Increasing stream velocities,
- Reducing groundwater recharge,
- Increasing the frequency and duration of high stream flows,
- Increasing inundation of wetlands during and after wet weather, and
- Reducing stream flows and wetland water levels during the dry season.

Figure 1.2 illustrates some of these hydrologic changes. As a consequence of these changes in hydrology, stream channels may experience both increased flooding and reduced base flows. Natural riffles, pools, gravel bars, and other areas may be altered or destroyed. Increased channel erosion, loss of hydraulic complexity, degradation of habitat, and changes in the composition of species present in receiving waters may follow.

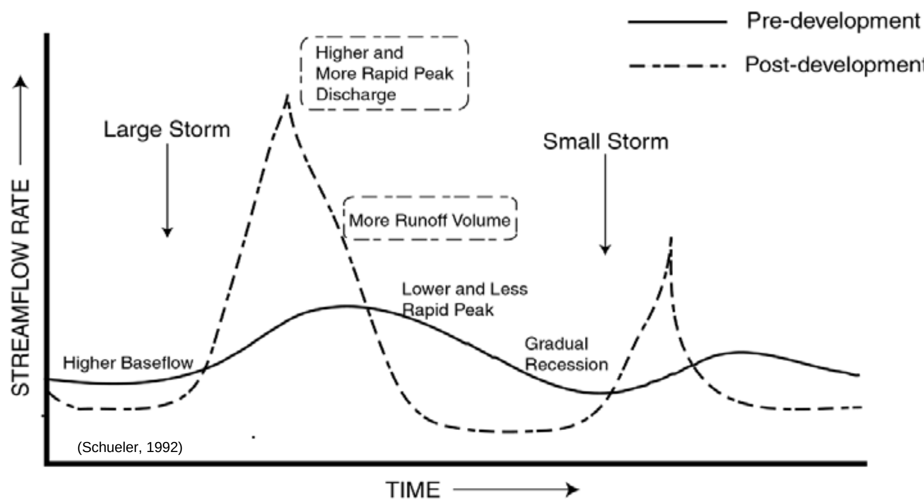

Figure 1.2 – Changes in hydrology following development

These changes do not result from any one project; they are the cumulative effect of all of the development in a watershed.

From a stream morphology standpoint, smaller flood events that approximate bankfull conditions and occur naturally every year or two (1.5 to 2-year frequency) are the most influential discharges and most easily changed with added urban runoff. It is these smaller flood events that shape the channel and are referred to as "effective flows" because over time they move the most sediment and transform the dimensions of a stream channel. When effective flows increase in size, duration, and frequency, the most common impact is changes in channel morphology to accommodate the rise in erosive energy delivered to receiving streams on an annual basis.

Although specific data and studies for eastern Washington are not currently available, research in streams in arid, semi-arid, and humid climate settings has shown that this accommodation commonly takes place by widening and down cutting of the streambed, damaging habitats and potentially reducing biologic diversity. Research has shown that as developed impervious areas reach five percent of land cover within a watershed, the connection between runoff from impervious areas and channel response through erosion begins to occur (Hajda, 1999; Hollis, 1975; and Booth, 1991).

Erosion problems from an aquatic ecosystem perspective are much more subtle than from an engineering perspective: streambank undercutting and failures occur long after changes to the habitat function of the streambed.

Stream channel erosion control can be accomplished by constructing BMPs that detain runoff flows and also by physical stabilization of eroding stream banks. Both types of measures may be necessary in urban streams, but only the former is covered in this Manual.

When comparing the pre-developed or existing conditions hydrograph with the proposed development condition hydrograph, the concern is not limited to the peak flow events; mitigating the duration of the flood flows is also important for stream channel stability and habitat. Detention basins that match peak runoff directly contribute more water to a stream over a longer period of time and extend the length of time the peak discharge rate is moving sediments in the streambed. The cumulative impacts of many detention basins operating in a watershed and merging downstream further compound flooding and erosion problems.

Because these changes are the cumulative result of development in a watershed, most new development in most watersheds must control flows. The intent of flow control is to prevent increases in the stream channel erosion rates that are characteristic of natural conditions by releasing runoff from the proposed development condition in a manner that delivers approximately the same amount of erosive energy to the stream as it received under pre-developed or receives under existing conditions.

Flow control in this Manual is targeted to smaller water bodies, especially first to third order streams or water bodies with contributing watershed areas of less than 100 square miles. These streams are most susceptible to changes in runoff patterns caused by development. In larger water bodies, the location of the development activity plays a greater role: in general, development that occurs nearer to a large stream channel and that does not encroach on the natural flood plain has less of an effect than development activities in the upper watershed – which are instead likely to impact smaller tributary stream channels.

This Manual provides guidance on stormwater management practices for controlling excess runoff volume from individual sites through flow control Best Management Practices (BMPs). Section 1.4.4 provides the background of developing these BMPs; Core Element #6 in Chapter 2.2.6 defines the requirements for applying these BMPs.

1.3 Relationship of this Manual to Federal, State and Local Regulatory Requirements

This Manual is one tool in the efforts to manage and reduce the impacts of urban stormwater discharges. At the date of publication of this Manual, several regulatory programs and permits exist that may directly or indirectly require a project proponent to properly manage stormwater.

1.3.1 Applicable Federal and State Regulations

The federal Clean Water Act, the federal Safe Drinking Water Act, and the state Water Pollution Control Act (RCW 90.48) are the primary federal and state regulations that directly apply to management of stormwater discharges. These laws are aimed at protecting water quality by controlling the amount of pollutants discharged to surface and ground waters. Other regulatory programs such as the federal Endangered Species Act and state Hydraulics Act also commonly require project proponents to properly manage stormwater to protect water quality and habitat. Specific permitting programs and other situations where stormwater management may be required by law are detailed in the following sections.

1.3.2 NPDES and State Waste Discharge Stormwater Permits for Municipalities

In Washington State, the cities of Seattle and Tacoma; King, Pierce, Snohomish, and Clark counties; and the Washington State Department of Transportation facilities within those jurisdictions have been subject to U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Phase I Stormwater Regulations (40 CFR Part 122). EPA adopted NPDES Phase II stormwater regulations in December 1999. Those rules identify additional municipalities that are subject to NPDES municipal stormwater permitting requirements. In eastern Washington there are no Phase I communities; Ecology has determined that fifteen cities and eight counties in the five census-defined urbanized areas of eastern Washington are subject to the requirements. The census-defined urbanized areas in eastern Washington are: Clarkston, Spokane, Tri-Cities, Wenatchee, and Yakima. Another five (Ellensburg, Moses Lake, Pullman, Sunnyside, and Walla Walla) or more additional municipalities may be subject to the requirements, depending upon an analysis that Ecology must perform. Federal regulations required that Phase II permits be issued by December 2002 and that designated Phase II communities submit an application for permit coverage by March 2003.

The federal regulations specify minimum measures for municipal stormwater programs for compliance with the Phase II rules. One of those measures is the adoption of a program for “post-construction stormwater management in new development and redevelopment.” Another is a program for “construction site stormwater runoff control.” This Manual provides technical guidance for projects to comply with municipal stormwater requirements in these two areas. For additional information on the Phase II municipal permit and the minimum control measures, see Ecology’s website and Ecology publication 03-10-076: *Model Municipal Stormwater Program for Eastern Washington*.

Local jurisdictions covered under the Phase II Municipal Stormwater NPDES Permit must apply this Manual or an approved equivalent to their own capital improvement and other public works projects. All local jurisdictions should work to identify and prioritize stormwater management actions that will effectively protect local water quality.

In Washington State under RCW 90.48, all permits for discharges of pollutants apply to discharges to groundwater as well as discharges to surface water. Jurisdictions applying for coverage under the Phase II Municipal Stormwater NPDES Permit will receive a combined NPDES State Waste Discharge Permit. At the time of publication of this Manual, Ecology was proposing that the Phase II Municipal Stormwater NPDES Permits would address discharges to groundwater. Where there are existing regulatory programs that address discharges to groundwater, Ecology would defer to those programs rather than duplicate or add new requirements. For discharges to groundwater that are covered under the Underground Injection Control (UIC) program (see section 1.3.5), Ecology would defer to the UIC program for the control of those discharges and not regulate those discharges under the Phase II Municipal Stormwater NPDES Permits.

1.3.3 Industrial Stormwater General Permit
(NPDES and State Waste Discharge Baseline General Permit for Stormwater Discharges Associated With Industrial Activities)

Businesses subject to the Industrial Stormwater General Permit have to prepare and implement a Stormwater Pollution Prevention Plan in accordance with the terms of that permit. The general permit, which was reissued August 2002, requires a description and implementation of operational source control BMPs and structural source control BMPs as applicable to their industrial activity. Additionally, application of erosion and sediment control BMPs, flow control BMPs, and treatment BMPs is required if necessary to address an erosion, flow, or pollution problem.

This Manual can be used to select and design stormwater BMPs for industrial sites eastern Washington.

1.3.4 Construction Stormwater General Permit
(NPDES and State Waste Discharge General Permit for Stormwater Discharges Associated With Construction Activity)

Operators of construction activities are required to seek coverage under the Construction Stormwater General Permit if the activity results in the disturbance of five acres or greater (including clearing, grading, and excavation activities) and also has a discharge of stormwater to a surface water and/or to a storm drain used to convey water to a surface water.

Beginning March 10, 2003, the U.S. Environmental Protection Agency’s Phase II Rule (Federal Register, Vol.64, No. 235, pages 68722-68852) requires operators of “Small Construction” activities disturbing greater than one acre of land to obtain an NPDES permit before discharging stormwater to a surface water or storm drain that discharges to a surface water.

The Construction Stormwater General Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must detail the various Best Management Practices (BMPs) that will be used during construction to prevent erosion and sedimentation that could impact downstream water quality. This Manual may be used by project proponents and others in the development of the SWPPP and in the selection, design, and application of erosion and sediment runoff control BMPs.

1.3.5 Underground Injection Control (UIC) Program

One of the provisions of the federal Safe Drinking Water Act is to protect underground sources of drinking water (USDW). The Underground Injection Control (UIC) program was established to protect USDW by regulating the discharges of fluids into the subsurface by underground injection wells. In 1984 Ecology adopted Chapter 173-218 WAC to implement the program.

Subsurface infiltration systems, such as drywells, are classified as Class V injection wells in the EPA's federal UIC program. The two requirements of the UIC program are:

- A non-endangerment performance standard must be met, prohibiting discharges that allow movement of fluids containing contaminants into potential underground sources of drinking water, and
- All UIC facility owners/operators must provide inventory information by registering the facilities.

Under the federal UIC regulations, the definition of an underground injection well is a bored, drilled, or driven shaft whose depth is greater than the largest surface dimension; or a dug hole whose depth is greater than the largest surface dimension; or an improved sinkhole; or a subsurface fluid distribution system which includes an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground. Examples of a UIC well or a subsurface infiltration system are drywells, drain fields, and pipe or french drains and other similar devices that discharge to ground.

Note: *Ecology is proposing to revise the existing UIC rule (Chapter 173-218 WAC). The proposed changes to the rule include rule authorization for properly managed stormwater from defined sources to be discharged to subsurface infiltration systems. Proper management would be based on following applicable best management practices as described in Ecology's current regional stormwater manuals or an approved equivalent manual. This Manual will be the applicable manual for eastern Washington. For more information about the rule revision contact Mary Shaleen-Hansen at* *maha461@ecy.wa.gov or (360) 407-6143, or visit Ecology's website at* http://www.ecy.wa.gov/programs/wq/grndwtr/uic

1.3.6 Endangered Species Act

Project proponents planning to discharge stormwater into bodies of water that provide habitat for threatened or endangered species are expected to properly manage their stormwater. This Manual may be used by project proponents to satisfy federal Endangered Species Act requirements as identified by the federal service agencies.

1.3.7 Section 401 Water Quality Certifications

For projects that require a fill or dredge permit under Section 404 of the Clean Water Act, Ecology must certify to the U.S. Army Corps of Engineers that the proposed project will not violate water quality standards, including state sediment standards. In order to make such a determination, Ecology may do a more specific review of the potential impacts of a stormwater discharge from the construction phase of the project and from the completed project. As a result of that review, Ecology may condition its certification to require:

- Application of the Core Elements and BMPs in this Manual; or
- Application of alternative requirements determined to be necessary to comply with state water quality standards.

1.3.8 Hydraulic Project Approvals (HPAs)

Under Chapter 77.55 RCW, the Hydraulics Act, the Washington State Department of Fish and Wildlife has the authority to require actions when stormwater discharges related to a project would change the natural flow or bed of state waters. The implementing mechanism is the issuance of a Hydraulics Project Approval (HPA) permit. In exercising this authority, the Department of Fish and Wildlife may require:

- Compliance with the provisions of this Manual; or
- Application of alternative requirements that are determined to be necessary to meet their statutory obligations to protect fish and wildlife.

1.3.9 Aquatic Lands Use Authorizations

As the steward of public aquatic lands, the Department of Natural Resources (DNR) may require a stormwater outfall to have a valid use authorization and to avoid or mitigate impacts to natural resources. Through its use authorizations, which are issued under authority of Chapter 79.90 through 96, and in accordance with Chapter 332-30 WAC, DNR may require:

- Compliance with the provisions of this Manual; or

- Application of alternative requirements that are determined to be necessary to meet their statutory obligations to protect the quality of the state's aquatic lands.

1.3.10 Requirements Identified through Watershed/Basin Planning or Total Maximum Daily Loads

A number of the requirements of this Manual can be superseded by the adoption of ordinances and rules to implement the recommendations of watershed plans or basin plans. Local governments may initiate their own watershed or basin planning processes to identify more stringent or alternative requirements. They may choose to develop a watershed plan in accordance with the Watershed Management Act (Chapter 90.82 RCW) that includes water quality and habitat elements. They may also choose to develop a basin plan in accordance with Chapter 400-12 WAC. As long as the actions or requirements identified in those plans and implemented through local or state ordinances or rules comply with applicable state and federal regulations (e.g., the Clean Water Act), they can supersede the requirements in this Manual. The determination of whether such local requirements comply with federal and state statutes must be made by the regulatory agency or agencies responsible for implementing those regulations.

Any requirement of this Manual may also be superseded or added to through the adoption of actions and requirements identified in a Total Maximum Daily Load (TMDL) that is approved by the EPA. However, it is likely that many TMDLs will require use of the BMPs in this Manual.

According to the federal NPDES Phase II rules, Ecology may include requirements in municipal stormwater permits including programmatic activities and other actions identified in completed TMDLs if those actions are deemed necessary to achieve the waste load allocation and restore water quality. In accordance with EPA's November 2002 policy "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," the waste load allocation itself will not become a permit requirement. The full text of EPA's policy can be viewed at http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf

1.3.11 Other Local Government Requirements

Local governments have the option of applying more stringent requirements than those in this Manual. They are not required to base those more stringent requirements on a watershed/basin plan or their obligations under a TMDL. Project proponents should always check with the local governmental agency with jurisdiction to determine the stormwater requirements that apply to their project.

Jurisdictions may have interconnected sewer systems. Neighboring jurisdictions are encouraged to work together to establish consistent design criteria for stormwater facilities since the climatic, geologic, and hydrologic variation among neighboring jurisdictions is likely to be minimal. Where municipal separate storm sewer systems are interconnected between jurisdictions with different requirements, the downstream jurisdiction's requirements apply.

1.3.12 Local Government Role in Implementing State/Federal Permit Requirements and Programs

Due to their knowledge and understanding of local water bodies, relationships with local businesses, and proximity to project sites, local governments can play an important role in implementing and enforcing permits and programs such as construction and industrial stormwater permits and the Underground Injection Control program. Ecology is ultimately responsible for implementation of these and other permits and programs in Washington State, but recognizes that these programs can have only limited success without the support and assistance of local jurisdictions.

Specific suggested "Responsibilities of Local Jurisdictions" are highlighted in Chapter 2.1.2 "Redevelopment" and in each Core Element in Chapter 2.2 of this Manual. These sections are provided as guidance for jurisdictions that are planning programmatic activities to manage stormwater to protect local water quality. A few of these potential roles may be further defined through the UIC rule revision and the Phase II municipal stormwater permitting process for those jurisdictions. But in most cases, Ecology simply hopes to develop and maintain a cooperative working relationship with the local jurisdiction and focus limited resources on sites with the greatest potential to impact water quality.

1.4 Best Management Practices for Stormwater Management

1.4.1 Best Management Practices (BMPs)

The method by which the Manual mitigates the adverse impacts of development and redevelopment is through the application of Best Management Practices (BMPs). The BMPs included in this Manual have been approved by Ecology; as new technologies are evaluated and approved, additional BMPs will be published as updates to this Manual.

BMPs are defined as schedules of activities, prohibitions of practices, structural facilities, maintenance procedures, and/or managerial practices that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State. The basic types of BMPs are (1) source control, (2) water quality treatment, and (3) flow control. BMPs that involve construction of engineered structures are often referred to as facilities in this Manual.

The primary purpose of using BMPs is to protect the beneficial uses of water resources (1) through prevention of contamination, (2) through the reduction of pollutant concentrations and loads, and/or (3) through management of discharge flow rates to prevent increased stream channel erosion. If it is found that beneficial uses are still threatened or impaired following the implementation of BMPs advocated in this Manual, then additional controls may be required.

1.4.2 Source Control BMPs

Source control BMPs prevent pollution or other adverse effects of stormwater from occurring. Most of these BMPs are common-sense "good housekeeping" measures and are targeted for various pollutant-generating activities and sources. Source control BMPs may be either operational or structural; examples include methods as varied as sweeping, using mulches and covers on disturbed soil, putting roofs over outside storage areas, and constructing berms around potential pollutant source areas to prevent both stormwater run-on and pollutant runoff. Core Element #3 "Source Control" in Chapter 2 defines the requirements for applying these BMPs; and Chapter 8 describes the procedures for implementing these BMPs.

It is generally more cost effective to use source controls to prevent pollutants from entering runoff than to treat runoff to remove pollutants. However, since source controls cannot prevent all impacts some combination of measures will usually be needed. Project proponent should try to design and place structures at the site so that stormwater does not come into contact with pollutants, reducing the requirement for treatment.

1.4.3 Water Quality Treatment BMPs

Water quality treatment BMPs include facilities that remove pollutants from stormwater by filtration, biological uptake, adsorption, and/or gravity settling of particulate pollutants. The need for a project to provide runoff treatment facilities depends on (1) the type and amount of pollutants expected to be generated by the completed project and (2) the vulnerability of the receiving waters to the pollutants of concern. A combination of BMPs may be required to protect the receiving waters.

Water quality treatment BMPs can accomplish significant levels of pollutant load reductions if properly selected, designed, operated, and maintained. Some water quality treatment BMPs are targeted for removal of a specific type of pollutant; others are effective at removing several classes of pollutants. Some BMPs may be appropriate only for certain climates or under other conditions.

It is not generally practical to treat 100 percent of the annual stormwater runoff volume generated by a project site. Some of the design specifications for water quality treatment BMPs in this Manual are established such that the BMPs are presumed to treat at least 90 percent of the total average annual runoff volume; this amount is considered to be a reasonable goal for capturing as many contaminants as practicable. Other BMP design specifications are based on treating the "first flush" of each storm event: stormwater produced by first rainstorm following a dry period during which pollutants have accumulated on impervious surfaces is commonly believed to carry a majority of the pollutants in urban runoff.

For groundwater, the potential of filtration through the vadose zone to remove the solid phase portion of the total concentration may result in concentrations meeting state groundwater quality standards (WAC 173-200). However, relying on the vadose zone to remove pollutants may result in contaminated soil, especially for sites with more than moderate to high pollutant loadings. See Chapter 5.6 for the background and rationale for allowing use of the vadose zone to provide treatment in certain cases.

Core Element #5 "Runoff Treatment" in Chapter 2 defines the requirements for applying these BMPs; and Chapters 4 and 5 describe the design criteria and procedures for implementing these BMPs.

1.4.4 Flow Control BMPs

Flow control BMPs may control the rate, frequency, and/or flow duration of stormwater surface runoff. Excess stormwater runoff volumes are generally managed by use of infiltration, evaporation, or detention facilities. On-site infiltration is the preferred means of disposing of stormwater runoff but is feasible only where more porous soils are available and the water table is not within 5 to 15 feet of the land surface, depending on local conditions. With the lower amounts of runoff in the arid and semi-arid climate of eastern Washington, infiltration is feasible in many areas of new development.

For projects with discharges to surface waters, detention ponds are designed and operated to meet established flow control requirements. The concept of detention is to collect runoff from a developed area and release it at a slower rate than it enters the collection system. The reduced release rate requires temporary storage of the excess amounts in a pond with release occurring over a few hours or days. The volume of storage needed is dependent on (1) the size of the drainage area; (2) the extent of disturbance of the natural vegetation, topography, and soils and creation of effective impervious surfaces – surfaces that drain to a stormwater collection system; and (3) how rapidly the water is allowed to leave the detention pond, i.e., the target release rates.

Historic flow control measures have focused on controlling runoff by matching the existing and proposed development peak flow rates for the certain recurrence intervals. This level of control does not adequately address the increased duration at which those high flows occur because the volume of water from the proposed development condition is increased as compared to the pre-developed and(or) existing conditions. The approach of only matching the peak flow rates fails to protect stream habitats from increased erosional energy.

To protect stream channels from increased erosion, it is necessary to control the durations over which a stream channel experiences geomorphically significant flows such that the energy imparted to the stream channel does not increase significantly. Discharges to lakes are controlled primarily to protect the outlet stream. Geomorphically significant flows are those that are capable of moving sediments; for most streams, these flows are within the 1.5- to 2-year range of recurrence intervals. If the pre-developed or existing condition 2-year peak runoff rate is met for the entire 2-year proposed development condition runoff volume, the stream experiences that flow rate for the longer period necessary to release the increased volume of runoff in the proposed development condition. In the absence of a continuous runoff model, a full duration standard cannot be achieved. A partial duration standard can be implemented by releasing the proposed development condition 2-year runoff volume at half of the pre-developed or existing condition 2-year peak flow rate, thus reducing the total erosional energy to somewhat nearer to that of the pre-developed or existing condition. This target will translate into lower release rates and larger detention ponds. The size of the facility can be reduced by reducing the extent to which a site is disturbed.

For discharges to wetlands, the objective of flow control is to not alter the natural hydroperiod. This means that flows from a development should be controlled such that the wetland is within certain elevations at different times of the year and that short-term elevation changes are within prescribed limits. If the amount of surface water runoff draining to a wetland is increased because of land conversion from native vegetation to impervious areas, it may be necessary to bypass some water around the wetland in the wet season. (Bypassed stormwater must still meet flow control and treatment requirements applicable to the receiving water.) If however, the wetland was fed by local ground water elevations during the dry season, the impervious surface additions and the bypassing practice may cause variations from the dry season elevations. Accurate estimates of what should be done to maintain the natural hydroperiod require data collection prior to the development activity and the use of a continuous runoff model.

Core Element #6 “Flow Control” in Chapter 2 defines the requirements for applying these BMPs; and Chapters 4 and 6 describe the design criteria and procedures for implementing these BMPs.

1.4.5 New and Emerging BMPs

Ecology encourages the development and implementation of new approaches to managing and treating stormwater. This Manual is intended to be a living document, and project proponents should check Ecology's website for additional BMPs that have been approved since the publication of this Manual. More information is provided in Chapter 5.12 about the new statewide protocol for testing new and emerging stormwater management technologies.

1.5 How to Apply this Manual

The users of this Manual will be engineers, planners, private industry, environmental scientists, plan reviewers, and inspectors at the local, state, and federal government levels. Ecology may approve other stormwater management manuals developed by local jurisdictions, the Washington State Department of Transportation, or other entities as being equivalent to this Manual. Local government officials may adopt and apply the requirements of this Manual directly or adopt and apply the requirements of an equivalent manual (see Section 1.5.2, Alternative Technical Manuals below). Local government staff may use this Manual or an equivalent manual as a reference for reviewing stormwater site plans; checking source control, runoff treatment, and flow control facility designs; and for providing technical advice in general. Private industry may use the Manual for information on how to develop and implement stormwater site plans and as a reference for technical specifications of Best Management Practices (BMPs).

The Manual itself has no independent regulatory authority. The Core Elements and technical guidance in the Manual become required only through:

- Ordinances and rules established by local governments; and
- Permits and other authorizations issued by local, state, and federal authorities.

Local jurisdictions may adopt and apply the Core Elements, thresholds, definitions, BMP selection processes, and BMP design criteria of this Manual or an equivalent manual. Staff at local governments and agencies with permitting jurisdiction may use this Manual in reviewing stormwater site plans, checking BMP designs, and providing technical advice to project proponents.

Federal, state, and local permits may refer to this Manual or the BMPs contained in this Manual. In those cases, affected permit-holders or applicants should use this Manual for specific guidance on how to comply with permit conditions.

Project proponents should start by reading Chapter 2 of this Manual. Chapter 2 explains the requirements of the Core Elements and defines how the Core Elements should be applied to individual projects and to particular levels of development.

For several of the Core Elements, thresholds are identified. These are the levels or conditions (e.g., project size or proposed land use) at or for which an action becomes required for that project. The thresholds presented in Chapter 2 are *technical thresholds*. However, *regulatory thresholds* may be established in ordinances, rules, permits or other authorizations; these thresholds are not included in this Manual but may modify certain thresholds that need to be met for a given project to comply with one or more Core Elements.

1.5.1 Stormwater Technical Manual

This Manual serves as a single technical stormwater manual for eastern Washington. It provides uniform stormwater management standards and is a central repository for BMPs. Ecology will maintain the region's technical stormwater manual for new development and redevelopment and will update, revise, and republish this Manual as appropriate.

1.5.2 Alternative Technical Manuals

Cities, counties, and other agencies may choose to develop alternative technical manuals. Those agencies and jurisdictions subject to state and federal regulatory programs that refer to this Manual may be directed to submit their manuals to Ecology. The submittal must include an outline of significant differences between the manuals and demonstrate how the alternative manual is substantively equivalent to this Manual. Ecology will work with jurisdictions to ensure that alternative manuals meet the regulatory objectives for which this Manual is being required (e.g., protection of water quality). Where Ecology is uncertain that a local jurisdiction or agency requirement provides sufficient protection, it may provisionally approve the requirement. The provisions would require the local jurisdiction or agency to implement an approved monitoring effort to assess the performance of the local requirement. Jurisdictions and agencies choosing to develop alternative manuals may be directed to adopt this Manual in the interim.